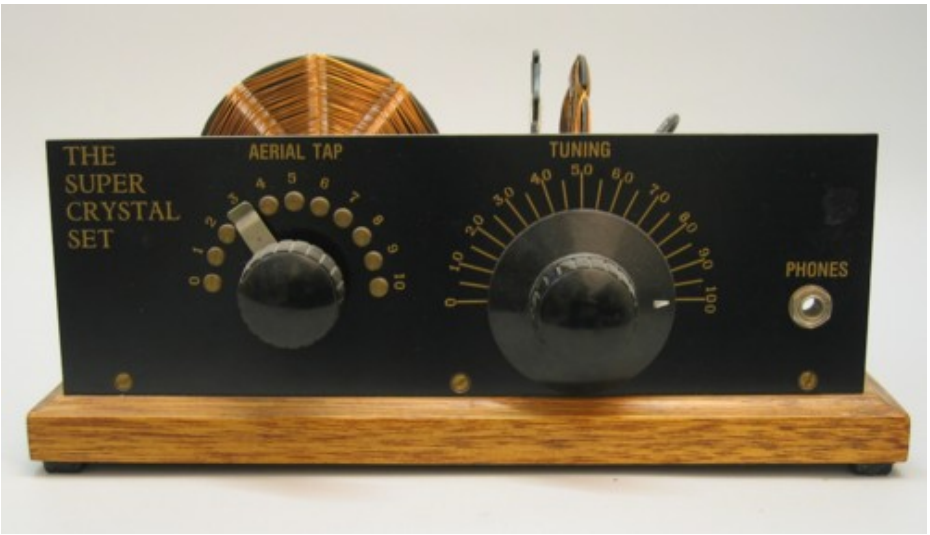
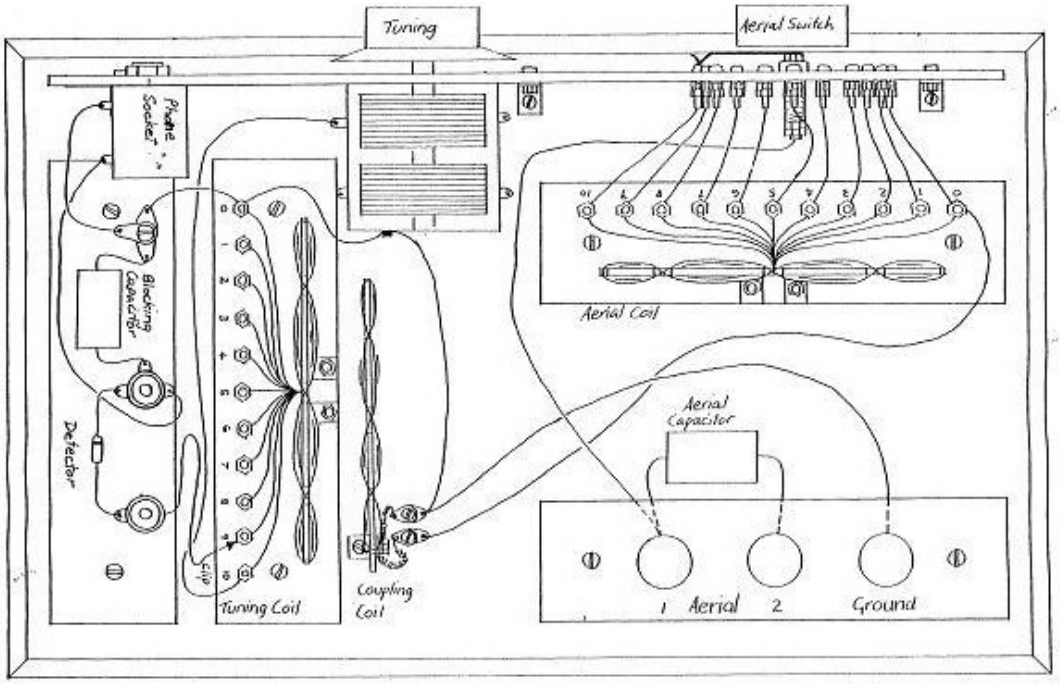
Crystal Set



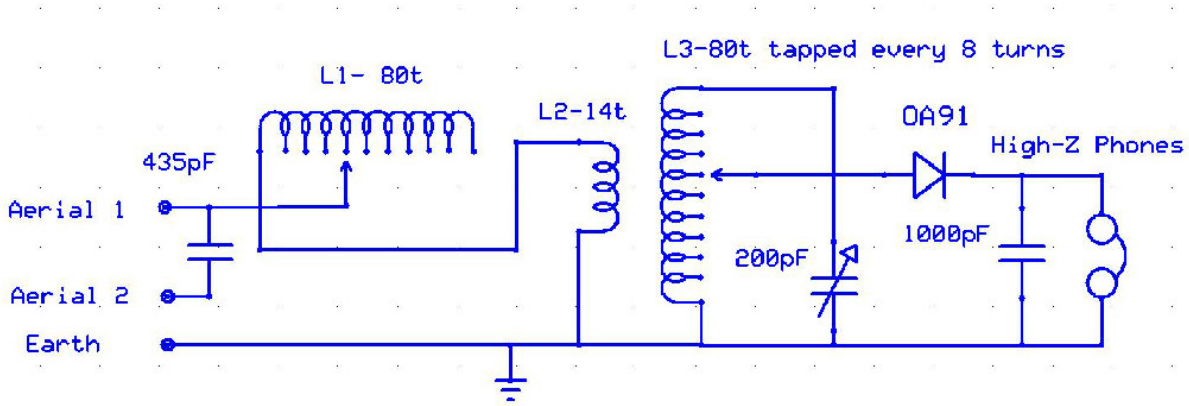
Many years ago I purchased a crystal set kit from Orpheus Radio in Ballarat. The design of the set was based on a 1920's naval radio and featured high-Q spider-web inductors, a variometer, mica capacitors and a rotary inductance selector switch. It is one of the best DX crystal sets I have ever owned. The selectivity and sensitivity are excellent and with this set I have been able to receive many stations from around Australia and south-east Asia. Unfortunately, Orpheus Radio doesn't seem to exist any more so for the crystal set enthusiast wanting to build this excellent radio apparatus, here is a description of that set. For the purist, the germanium diode can be replaced with a cat's whisker detector to produce a totally authentic piece.

Headphones

Before the construction of a crystal set is contemplated, a pair of high quality high-impedance headphones should be obtained. The performance of the crystal set is highly dependant upon the quality of the phones. It is possible (and I have done so) to modify a set of standard 600 ohm headphones to produce an excellent pair of high-impedance phones. The modifications include complete disassembly of the phones and tediously re-winding the coils. This is not a job for the feint-hearted but if your sense of adventure extends this far then the results can be very satisfying.



A sketch showing the layout of the crystal set



Schematic of the crystal set

Circuit Description

The crystal set incorporates an aerial tuning circuit that is quite separate from the main tuning. Altering the aerial switch selects an appropriate tap on L1 to bring the aerial circuit in to tune. The 435pF aerial capacitor C1 will enable the circuit to tune a long aerial. In some cases, it may necessary to reduce the value of this capacitor to enable a very long aerial to be brought into tune.

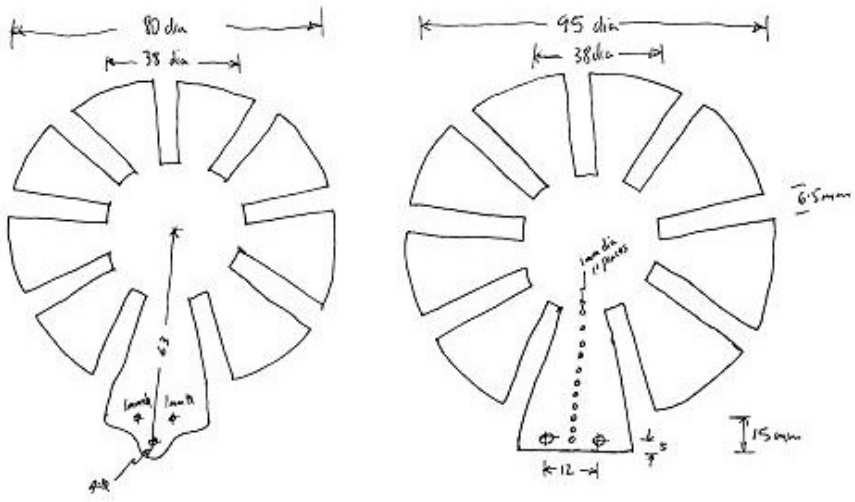
Following the aerial circuit is the variometer coil L2, used to control the amount of RF coupling to the main tuned circuit. As L2 is pivoted away from the tuning coil L3, the amount of interaction (or mutual inductance) between these coils is reduced. In this way the amount of energy drawn from the aerial circuit is minimized, maintaining sharp tuning of the set.

The main tuning circuit consists of L3 and the tuning capacitor C2. This circuit is energised via the

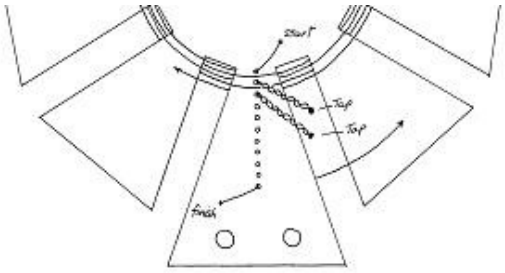
aforementioned variometer and some of its energy is drawn off to feed the detector circuit consisting of D1 and C3. As with the aerial circuit, it is important that the energy drawn from the tuned circuit is minimised. This is achieved by the tap selection on L3. For a given detector arrangement, an optimum tap is selected using the flying lead and alligator clip.

Construction

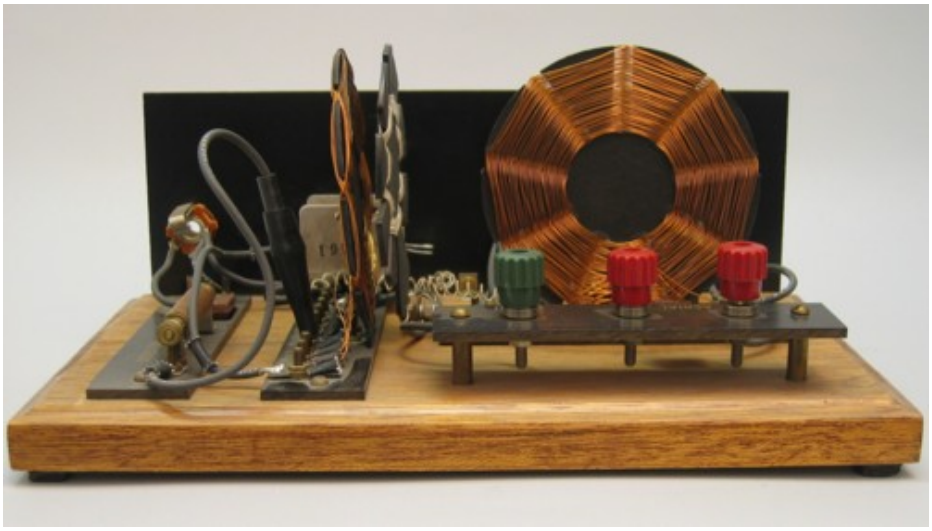
The coils are wound in the spider-web style and due to the low inter-winding capacitance of this winding arrangement, a coil of very high Q results. The details of the former and winding format are illustrated in the following sketches.



Spider-web coil formers, variometer on the left and aerial and tuning coils on the right



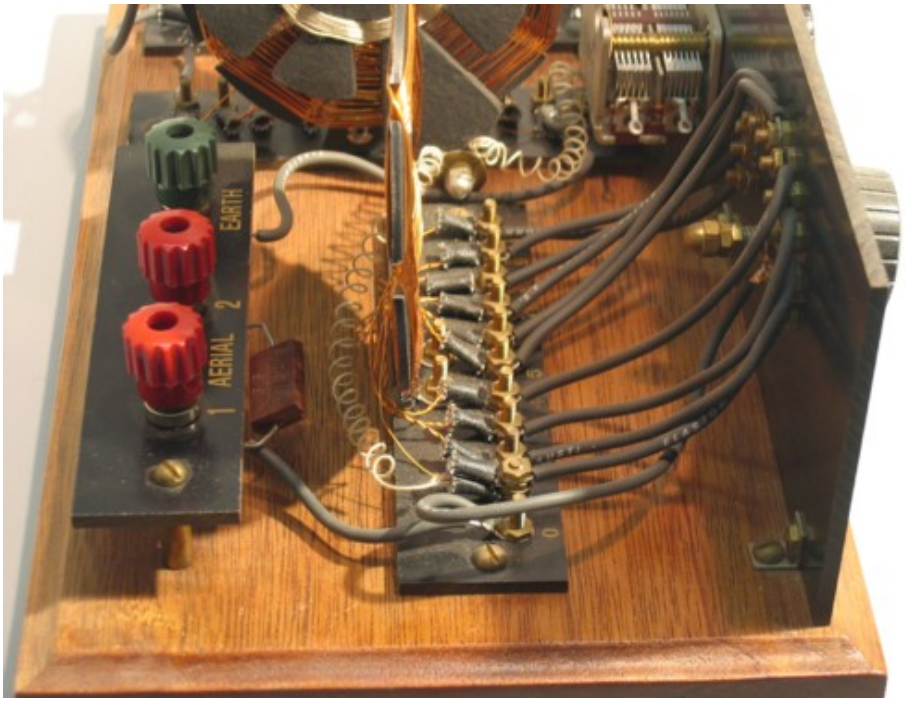
Coil winding details - aerial loading coil (L1) and tuning coil (L3) - 80 turns of 26g B&S enamelled wire with a tap every 8 turns. variometer coil (L2) - 14 turns



Rear view of the crystal set

Aerial coil taps

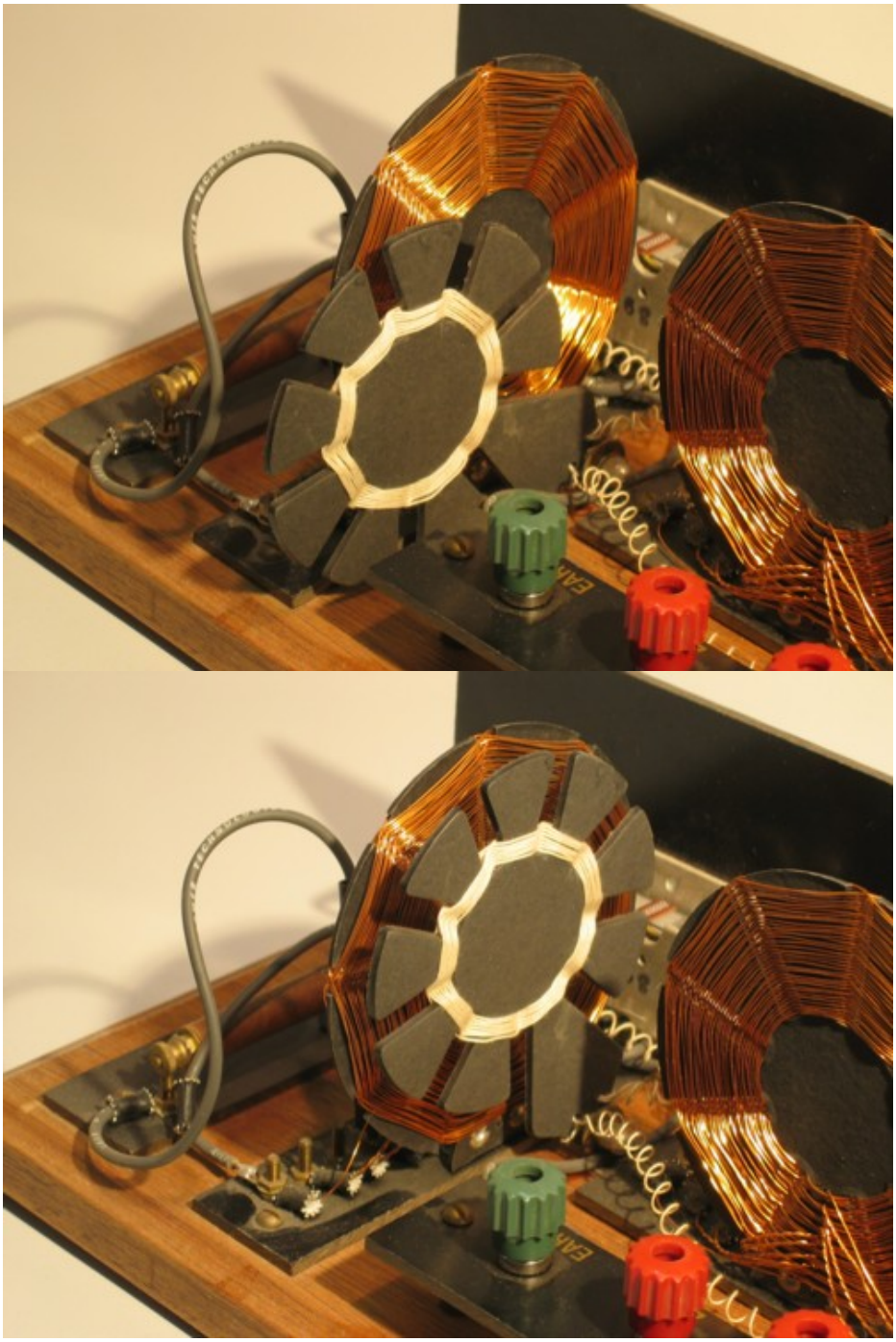
The coupling coil (variometer) is pivoted at its mounting bracket to allow the amount of RF coupling to be adjusted by the operator. For best selectivity, it should be adjusted for the least amount of coupling possible. Increased coupling will provide increased volume but the selectivity of the set will deteriorate markedly.



Aerial coil taps

Operation

The set requires a substantial aerial and earth system for best performance. It can be a little tricky to operate as several separate tuning operations are required. One operation selects the appropriate station by turning the tuning knob and the other tunes the aerial circuit by adjusting the aerial taps. Additionally, the variometer and detector tap will need to be adjusted and the correct aerial terminal selected (terminal 1 for short aerials and 2 for long ones). All of this makes for an interesting and challenging pastime. A log book is useful for recording the various adjustments so that an interesting station can be revisited at a later date.



The variometer set for minimum and maximum coupling

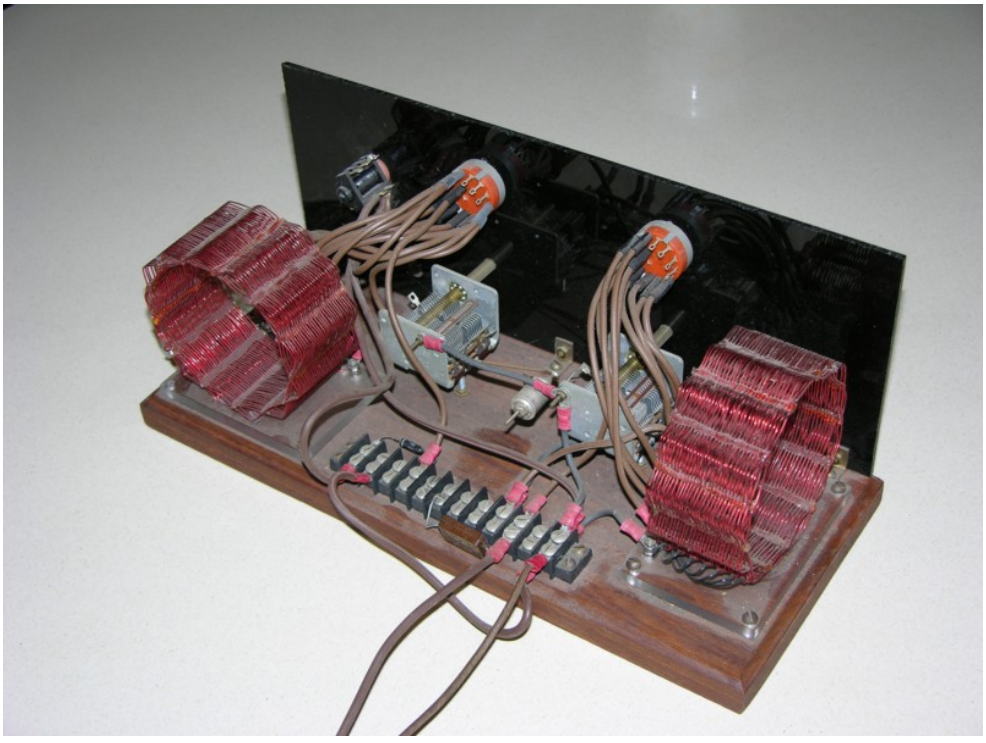
To operate the set, connect the aerial and earth, plug in the high-impedance headphones, set the aerial tap to 0 and set the variometer for maximum coupling. It should now be possible to find a station using the tuning control (C2). Once a station is found, reduce the variometer coupling as much as possible while still hearing the station. Now adjust the aerial tap to find a peak. When this is found it should be possible to further reduce the variometer coupling and re-tune for best signal. The detector circuit tap should be set as low as possible to provide the best selectivity of the set.

Detector set to tap no. 7

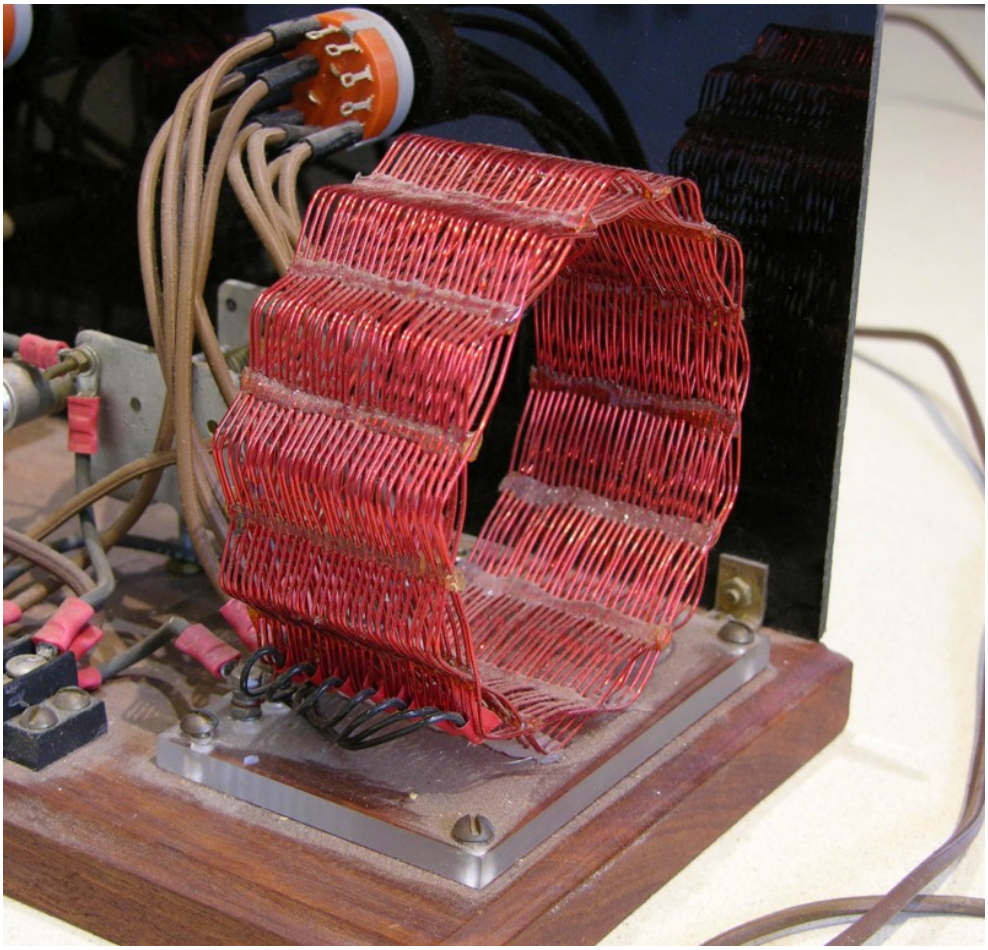
With careful operation of the controls it should be possible to select even quite weak stations from amongst the stronger signals. With a skilled operator, the performance of this crystal radio is quite remarkable.

A Variation on the Design

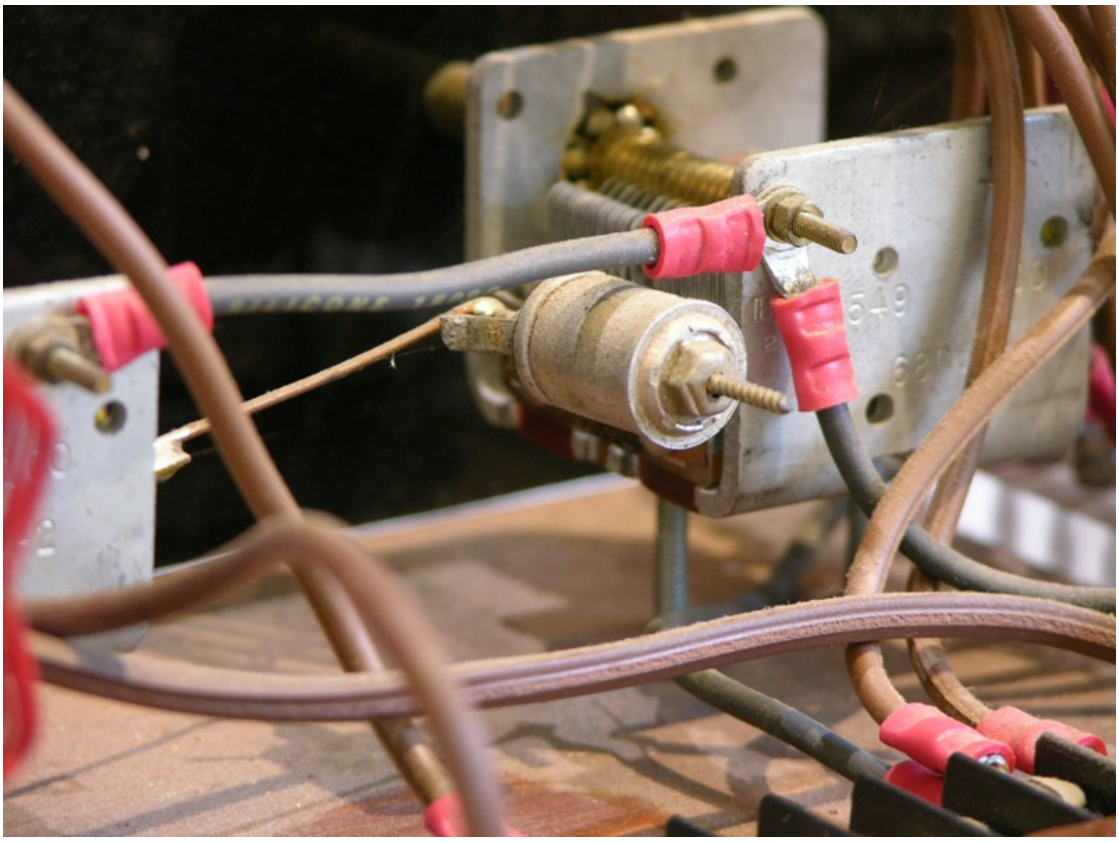
When cleaning out my shed the other day I came across a set that I had constructed many years ago. It is a variation on the Orpheus design with a small beehive trimmer capacitor used to control the coupling between the tuned circuits in place of the variometer. Also, a different approach to the coil winding design is used.



Rear View



Aerial Coil - Note the alternative method used to reduce inter-winding capacitance.



The small trimmer capacitor is used to couple the tuned circuits. Like the design using a variometer, it is adjusted to optimise the trade-off between sensitivity and selectivity.